COST REDUCTION THROUGH WASTE MANAGEMENT IN AUTO PARTS INDUSTRY: A CASE STUDY

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Abstract— Industrial waste elimination is a major challenge that is faced by all the companies in the day-to-day activity of manufacturing systems. There are seven types of industrial waste in lean systems such as movement, waiting, over-production, inventory, over-processing, defects and transportation. Every industry faces same type of waste that occurs in day-to-day production activities. Muda directly or indirectly affect the production cost. Poor production cost is considered as major problem in case industry. The objective of this study is to reduce the muda from side stand process line. In this study, two techniques are used to achieve the objectives. Value stream mapping (VSM) is a state of the art technique used to find out the major flaws in side stand process and ECSR (Eliminate Combine Simplify Reduce) technique is applied to identify the opportunities for saving. Along with the application of VSM and ECSR techniques, corrective actions are taken to reduce the muda from process flow of side stand from which higher process capability is achieved. It was observed that wastage of material`s movement was reduced by 94.4%. As proposed in model, the Work in Process (WIP) inventory has been reduced by 76.4% and workforce by 15.38%. Further, it would lead to the profit of Rs. 15738.4 per month.

Keywords— Value Stream Mapping (VSM), TAKT Time, Work In Process Inventory (WIP), Kaizen.

I. INTRODUCTION

Each and every time economic crises disturb the corporation's turnover than companies think about their manufacturing systems, find the wastages and eliminate them to reduce the production cost. This idea was invented from lean manufacturing and then the problem was defined as 3M (Muda, Muri, and Mura). Lean manufacturing is well organized way to eliminate the wastage in the manufacturing system. Lean is derived from Japanese manufacturing system. TPS (Toyota production system) is the manufacturing system where lean is developed and implemented.
Principle goal of this framework is to dispense with wastages, for example, Muda (wastage in manufacturing system), Muri (overburden on worker) and Mura (imbalance in the system). Both Mura and Muri is the extension of the Muda.
As shown in **Fig.1.** and according to Tim Wood, Muda have seven types of wastages as described below:-

a) Wastage through transport: It is unreasonably transportation of material, tools and persons that are not required in performing the process as they influence the production cost and quality.
b) Wastage via inventory: It is stock of material in the store, which relates to the money that is on hold and not even earns any interest on it.
c) Wastage through movement: This kind of wastage is apprehensive with unnecessary motion of worker and material between the processes that increase the cycle time. Main causes behind this wastage are poor layout.
d) Wastage through waiting: Waiting is apprehensive with period of time between the operations. It mostly occurs in the system due to lengthy runs and poor manufacturing.
e) Wastage through over production: It is producing of products more than its demand in the market. It derives high stock level and connections with the cost, and delay in identification of the material.
f) Wastage through over processing: It is the failure of process design. It implies the process and workforce utilization and technology.
g) Wastage through defects: This kind of waste is generated from the defective products that are considered in rework and scrap pieces. This is generated with the mistake of worker, ineffective machines, poor control on tolerances.

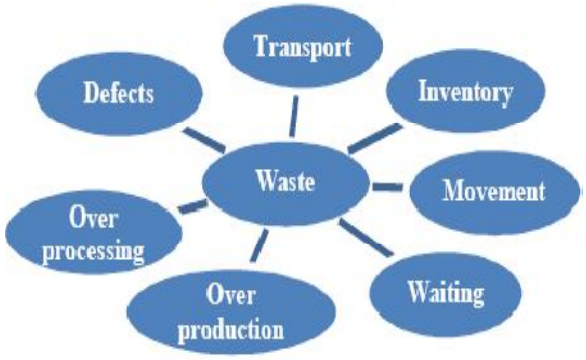


Fig.1. Seven types of wastes.

The case industry started its journey in 1979 with the vision of becoming quality supplier of the auto parts for the original equipment manufacturers. It is public limited company but mostly its shares are held within the family. Firstly, company was the vendor of Speedomax, Omax and Hema Engineering Company. But presently it supply directly to the automotive company such as Hero Motocorp, Honda Motorcycle and Scooter India and International Tractor Limited.

II. LITERATURE REVIEW

In 1978, Ohno improved the process flow by eliminating waste, instead of putting all the machines of a single type at same place, the machines were assigned in operational ways. By this type of assignment one worker to more machines, this system increased production efficiency by 2-3 times [1].

Kumar et al. [2] used TQM approach to found the scrap in one of the leading Indian industries manufacturing pre-stressed concrete steel strands (PC wire) having major applications in bridges and construction industry. After applying cause and effect diagram and Pareto analysis, scrap because of left over rings were reduced step by step by taking suitable actions.

Shukla and Agarwal [3] applied TQM approach to reduce the cost of poor quality in the auto industry to overcome various problems related to poor quality.

Kumar (2013) used the Root Cause Problem Solving (RCPS) technique in Cheema Boilers Limited, India to reduce the scrap rate during production process. Pareto charts were used to identify the waste for intend of improvement. Quality control tools were used to analyze the cause of wastage to formulate and execute the corrective action. After taking action, scrap was reduced to 4.5% from 9%. [4]

Gracanin et al. [5] used value streams optimization for allocating the indirect manufacturing costs and excluding time manufacturing in any production facility and to reduce them. For this visualization, cost-time profile was a powerful tool, which accumulates during the time across the entire production line. Basically, it emphasizes the relation between money and time.

Venkataraman et al. [6] implemented lean manufacturing techniques (VSM, Kaizen) in the crankshaft manufacturing systems at an automotive manufacturing plant to meet the company's quality, cost and delivery targets. After implementing lean manufacturing techniques, the manufacturing lead-time reduced by 40%, defects were reduced; higher process capability achieved and quick response to customer demand in small lots was achieved.

Singh et al. (2014) used VSM (Value Stream Mapping) approach in the auto-part industry. This research was started with data collection of all the process via which current state was created, after considering the problems in current a future state was suggested to result in a reduction of 22% process time, 33.7% lead time, 50% reduction in inventory [7].

Manjunath et al. [8] purposed to recognize about the value of VSM (Value Stream Mapping). When current and future states were compared then, 38.2% lead time, 2.65% process time and 48.35% inventory reduced.

Wenchi et al. [9] used the VSM technique for measuring the efficiency of TAM (Turnaround Maintenance) improvement in oil and gas industry. Firstly, root causes and wastes were found by creating current state then after analyzing the current state it was found that VSM technique was feasible for TAM project.

Patel et al. [10] reviewed the VSM technique for eliminating the non-value auxiliary leftover and upgraded the processes for further improvement in business, for that firstly the information of each workstation about cycle time, Work in Process inventory and workers required was collected and after that, the information was analyzed for removing waste.

III. CASE STUDY

3.1. Problems in the Current System

The auto parts industry mainly produces parts for automobile and various tractor parts. Poor production cost seems to be the major problem in this sector, which needs to be resolved. Case industry was one of the automobile industries, which was facing with the problem of poor production cost that was noticed to be Rs. 52126.16 annually for side stand process. There was various waste elements present in the process flow of side stand, which influenced the production cost to some extent like rework, scrap and movement cost.

3.2. Objectives of the Present Study

The present work was carried out with the following objectives:-

1. To identifies the various waste with the help of lean management.
2. To reduce the production cost by eliminating waste.

IV. PRESENT WORK

4.1. Review of the Production Process

There are six different manufacturing shops and 80 plus products are manufactured in the industry. Major products are Sprockets, Link Engine Hanger, Side Stand, Pedal Gear Change and Break, Engine Pipe, Main Stand, Break Arm and Inner Shaft. Major problems in the industry are movement loss, reworking and scrap.

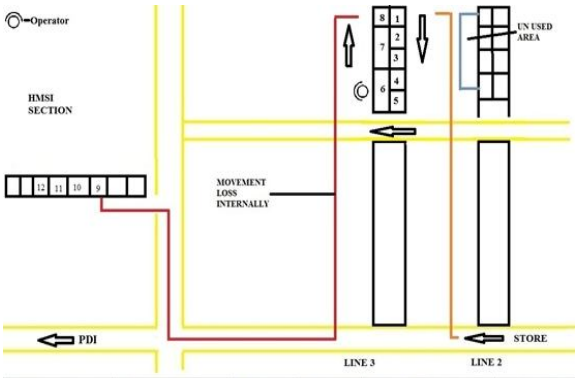
4.2. Problem Identification

Movement Loss was major loss in the organization, which affects the production cost. Approximately 7 minutes was wasted in single movement of side stand process and 20 movements in a day so, 140 minutes can be saving from overall production process. Due to movement loss, work in process inventory can be reduced and number of workers can also be reduced.

4.3. Analysis of Process Flow of Side Stand

Fig.3. shows the problems identified in the system like extra operator, improper utilization of workplace and internally movement loss in the system. This

internally movement loss continuously affects the total production cost in hidden way.



1. Pipe, pivot and pin tacking	2. Complete welding	3.Pin welding	4. Tread tacking	5. Tread complete welding	6. Tapping
7. Slip gauge grinding	8. Over welding grinding	9. Burs cleaning	10. Visual	11. Alignment checking	12. Final inspection

Fig.2. Process flow of side stand.

Fig.3. shows the poor production cost trend of side stand from December 2015 to February 2016. The average of poor production cost of side stand has approximate 26.70%, which affects the production cost of side stand.

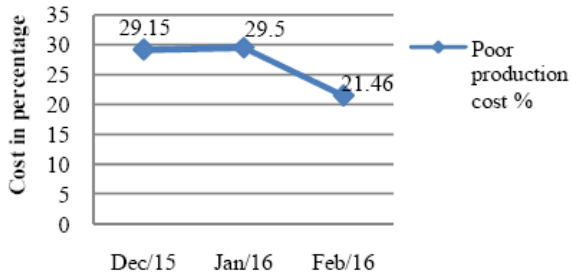


Fig.3. Month wise poor production cost.

Fig.4-6 shows the Pareto analysis of different factors those are responsible for increasing the production cost of side stand. Different factors involved were rework, scrap and movement cost of three months (December-2015, January-2016 and February-2016). Firstly, rework analysis is shown, secondly scrap cost data analysis is shown after that movement cost data analysis and in the last combination of all three factors.

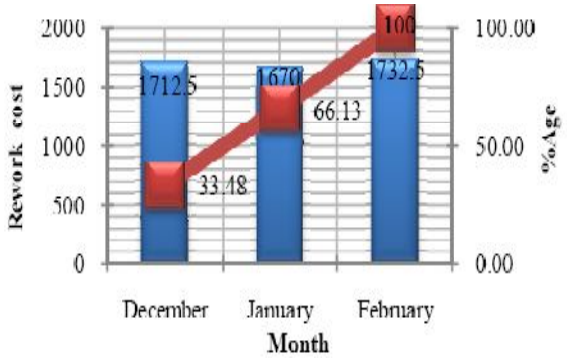


Fig.4. Rework cost data analysis.

Rework cost was analyzed on last three-month data as shown in **Fig.4.** Basically, rework was the factor which increased the production cost. In side stand process, rework cost is Rs 1.25. Reworking factors was not constant; it always changes because it is directly proportional to worker inattentiveness.

Scrap cost factor was also considered as poor production cost and its analysis is shown below in **Fig.5.** This factor was directly proportional to worker carelessness and line caption inattentiveness. Scrap cost is the actual cost of the piece that is Rs 25.14.



Fig.5. Scrap cost data analysis.

Movement cost was the hidden factor, which affects the production cost internally. Movement cost analysis shown below in **Fig.6.** It was relating to the wastage of time for movement, which increases the overall production time. In the industry, 60-minute wastage cost is Rs 33.33.



Fig.6. Movement cost data analysis.

4.4. Current State Map of Side Stand Process

Fig.7. shows the current state map for side stand process, in which TAKT time, process ratio, and major waste is shown, that is movement between the operations over weld and pressure cleaning.

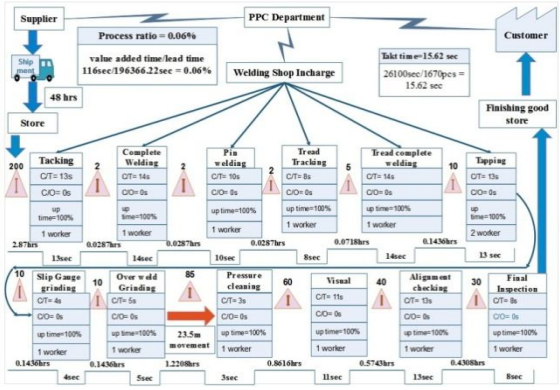


Fig.7. Current state map.

Table 1 shows the analysis of the current state map for different parameters such as number of operators, production lead-time, process ratio, number of operations traveling distance and work in process inventory.

Table1: Summary of Current State Map

S. No.	Variables	Value
1	No. of operators	13
2	Production lead time	54.54 hrs
3	Process ratio	0.060%
4	No. of operations	12
5	Traveling distance	23.5m
6	Work in process inventory	85 pcs

Fig.8. shows the cycle time (in seconds) for current state map where red line shows the TAKT time and blue bar shows the cycle time for different operations. All the operations are under the TAKT time.

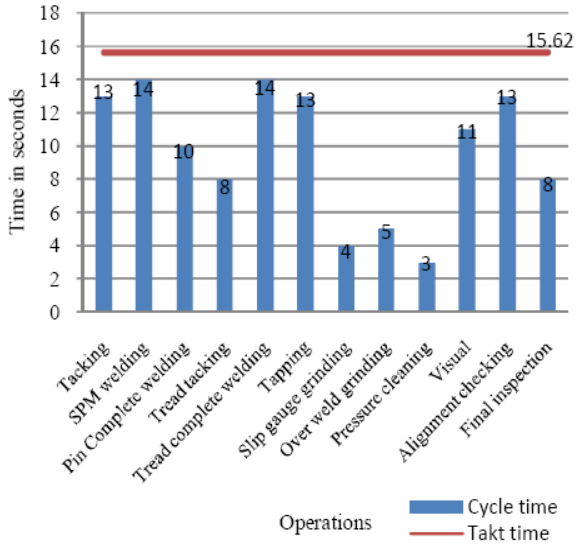


Fig.8. Cycle time of different operations.

Various opportunities have been found as shown in **Fig.9.** for reducing the cost of side stand process. Different steps are considered such as waste elimination, method improvement and investment in side stand process for reducing the cost.

Brainstorming is the best tool of finding the solution of every problem. In this process, numbers of ideas were generated for solving the problems, from these ideas an appropriate idea is selected for finding the solution of the problem. **Fig.10.** shows the ideas generated for reduction of production cost for side stand.

Fig.11. indicates the maximum possible reasons of rework for side stand. Man, machine and method are main elements of the fishbone diagram. Counter measure of rework are shown in Table 2. The main reasons for production loss are untrained and overburdened manpower, non proper identification of methods and calibration of alignment fixtures.



Fig.9. Identification through ECSR (Elimination Combine Simplify and Reduce).

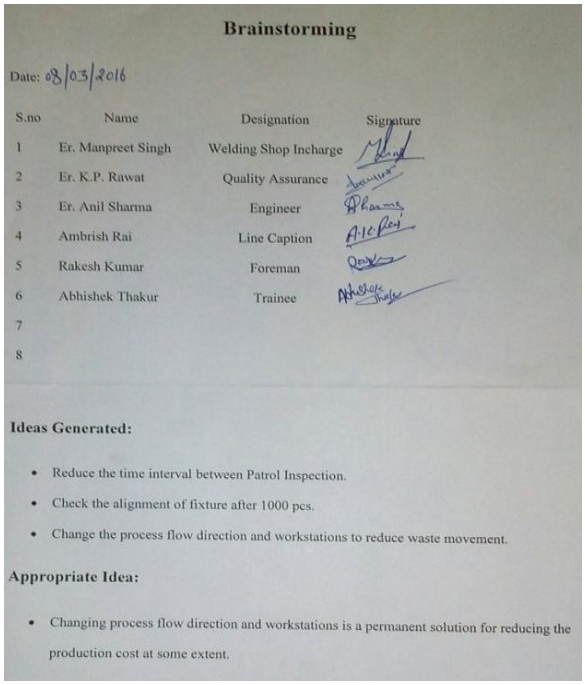


Fig.10. Brainstorming on Problems in the Industry.

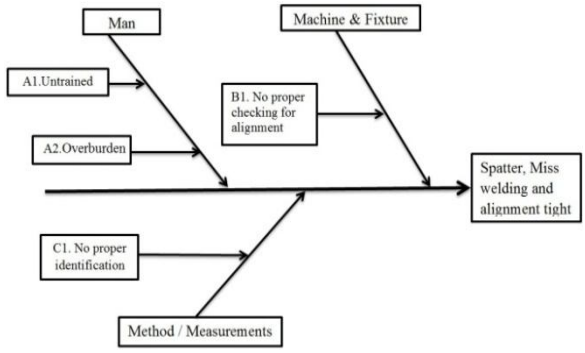


Fig.11. Fishbone Diagram.

V. RESULTS AND DISCUSSION

5.1. Overcomes for Rework

Table 2 shows the counter measures of rework for different elements such as Man, Machine and Fixture and Method and Measurement.

Table2: Countermeasures of Rework

Activity	Counter Measures of Rework (Man)
A1	Sufficient training should be provided to the worker about the work and machine, worker should know about all the parameters of machine, which they operate.
A2	For giving the target to the worker, firstly it is the responsibility of the line captain and foreman to measure the cycle time of the machine and operator efficiency so that operators should not feel pressurized while working.
	Counter Measures of Rework (Machine and Fixture)
B1	It is the responsibility of the line captain to check the fixture for the alignment of the work piece after every 1000 pcs.
	Counter Measures of Rework (Method and Measurement)
C1	Reduce the time between patrol inspections and increase the number of samples for measurements.

5.2. Future State Map of Side Stand Process

Fig.12. shows the future state map for side stand process, in which TAKT time, process ratio, and solutions for reducing waste is shown, that is reducing movement and combining various operation and merging machines to solve the objectives.

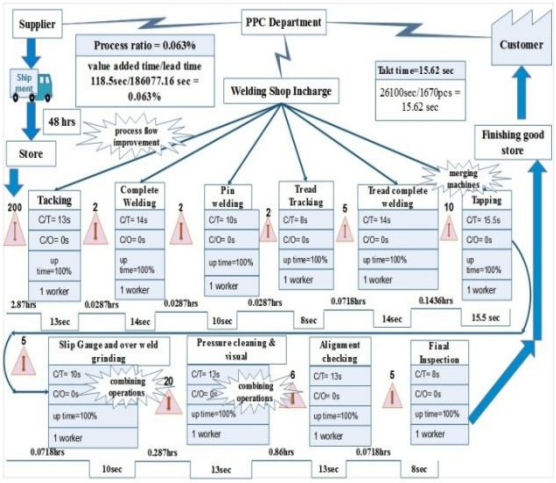


Fig.12. Future State Map of Side Stand Process.

Fig.13. shows the cycle time (in seconds) all operations are under the TAKT time. Even after merging machines at tapping operation cycle time is under the TAKT time line and four operations such as slip gauge grinding, over welding grinding, pressure cleaning for burs and visual are combined in the set of two then operation cycle time is increased but not exceed the TAKT line.

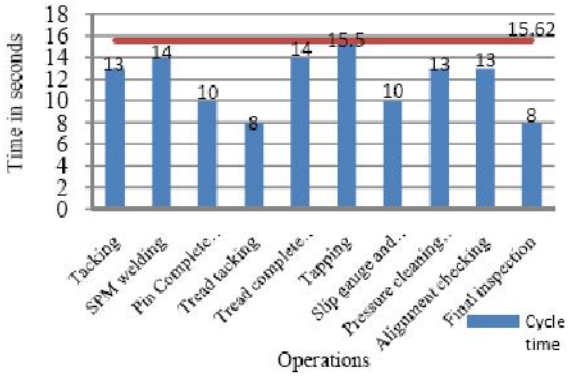


Fig.13. Cycle Time of Different Processes (Future State Map).

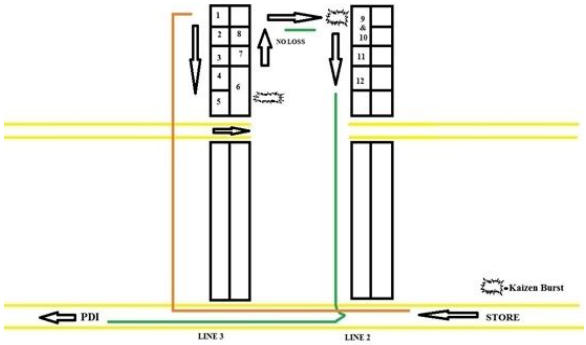
Table 3 shows the comparisons between current and future state map. All the parameters are improved in comparison to current state.

Table3: Comparison between Current and Future State

S. No.	Variables	Current	Future	Progress
1	No. of operators	13	10-11	15.38% decrease
2	Production lead time	54.54 hrs	51.68 hrs	5.24% decreased
3	Process ratio	0.060%	0.063%	5% increased
4	No. of operations	12	10	16.66% decreased
5	Traveling distance	23.5m	1.3m	94.4% decreased
6	Work In Process Inventory	85	20	76.4% decreased

5.3. Proposed Process Flow

Fig.14. shows the proposed process flow in which all the problems are addressed like proper utilization of work place, total number of the worker according to the production.



1. Pipe, pivot and pin tacking	2. Complete welding	3.Pin welding	4. Tread tacking	5. Tread complete welding	6. Tapping
7. Slip gauge grinding	8. Over welding grinding	9. Burs cleaning	10. Visual	11. Alignment checking	12. Final inspection

Fig.14. Proposed Process Flow.

5.4. Kaizen: On Merging Machines

Kaizen means change for good. Here, Kaizen is done for fully utilize of the machines and the operator efficiency in the side stand process. Kaizen working

under 1350 pcs approximately schedule for a day, if production schedule is above than 1500 pcs then this is not suitable.

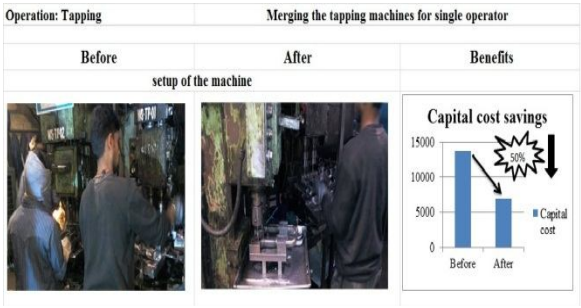


Fig.15. Kaizen on Merging the Machines.

CONCLUSIONS

It was concluded that waste management plays a vital role in solving the problem of poor production cost. Value Stream Mapping (VSM) was used to represent the wastage in the system and fish-bone diagram is used to show major causes of rework. At proposed working conditions to some extent, the production cost has shown reduced.

1. Movement was one of the reasons affecting the production line of side stand, which further affects the production cost. After implementation of waste management 94% of the movement was reduced, which saves up to Rs. 2038.4 per month.
2. Checking apparatus for arrangement of the work piece once each 1000 pcs and expansion the number of tests for measure.
3. Two operators were decrease from process line of side stand by combining the operations such as slip gauge or over welded grinding and pressure cleaning or visual inspection, which finally lay to save an amount of Rs 13700 per month.

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